Benthic TMDL for Toms Brook

Final Public Meeting

January 13, 2004

Institute for TMDL Studies at Virginia Tech

Biological Systems Engineering Department

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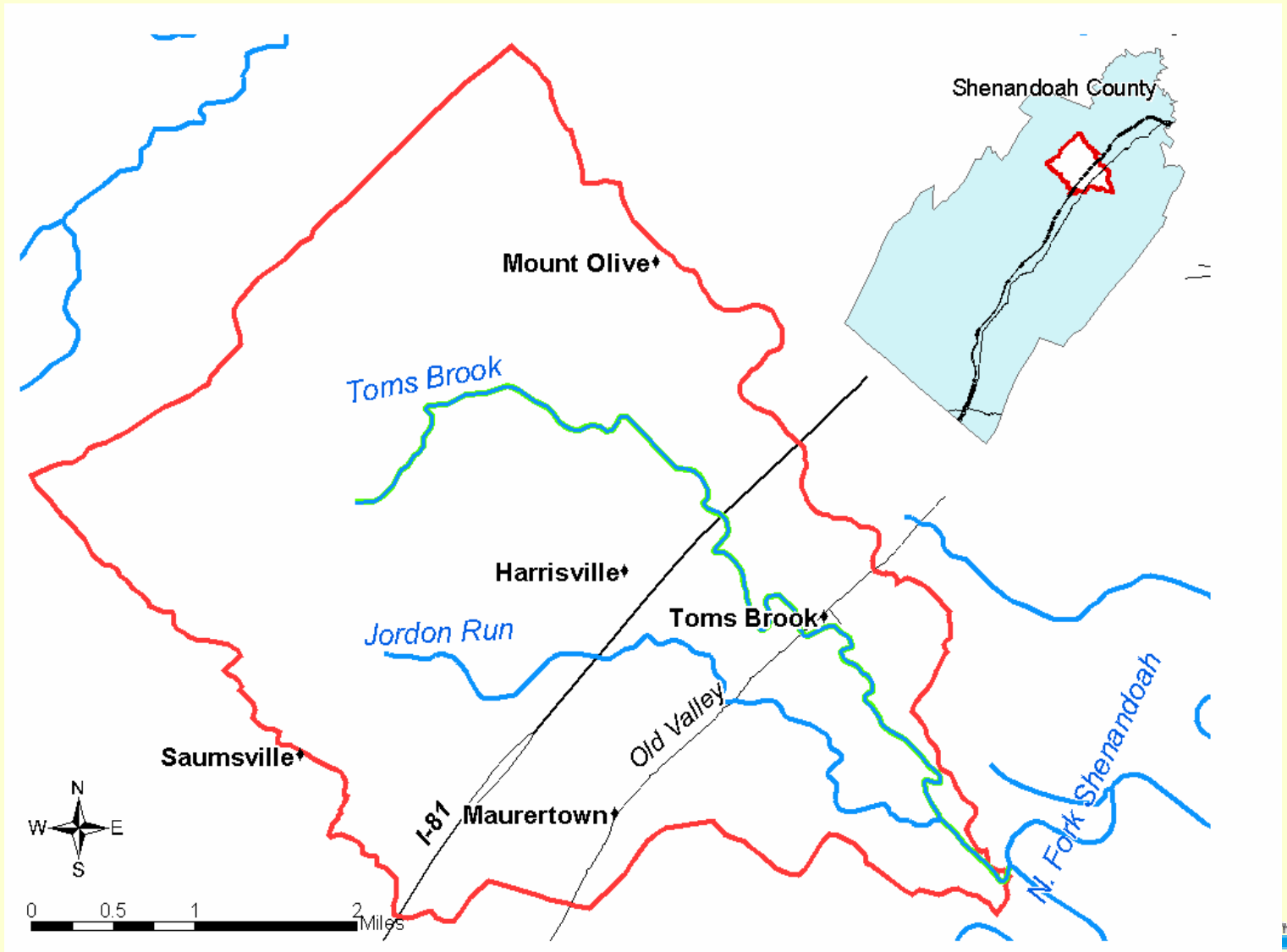
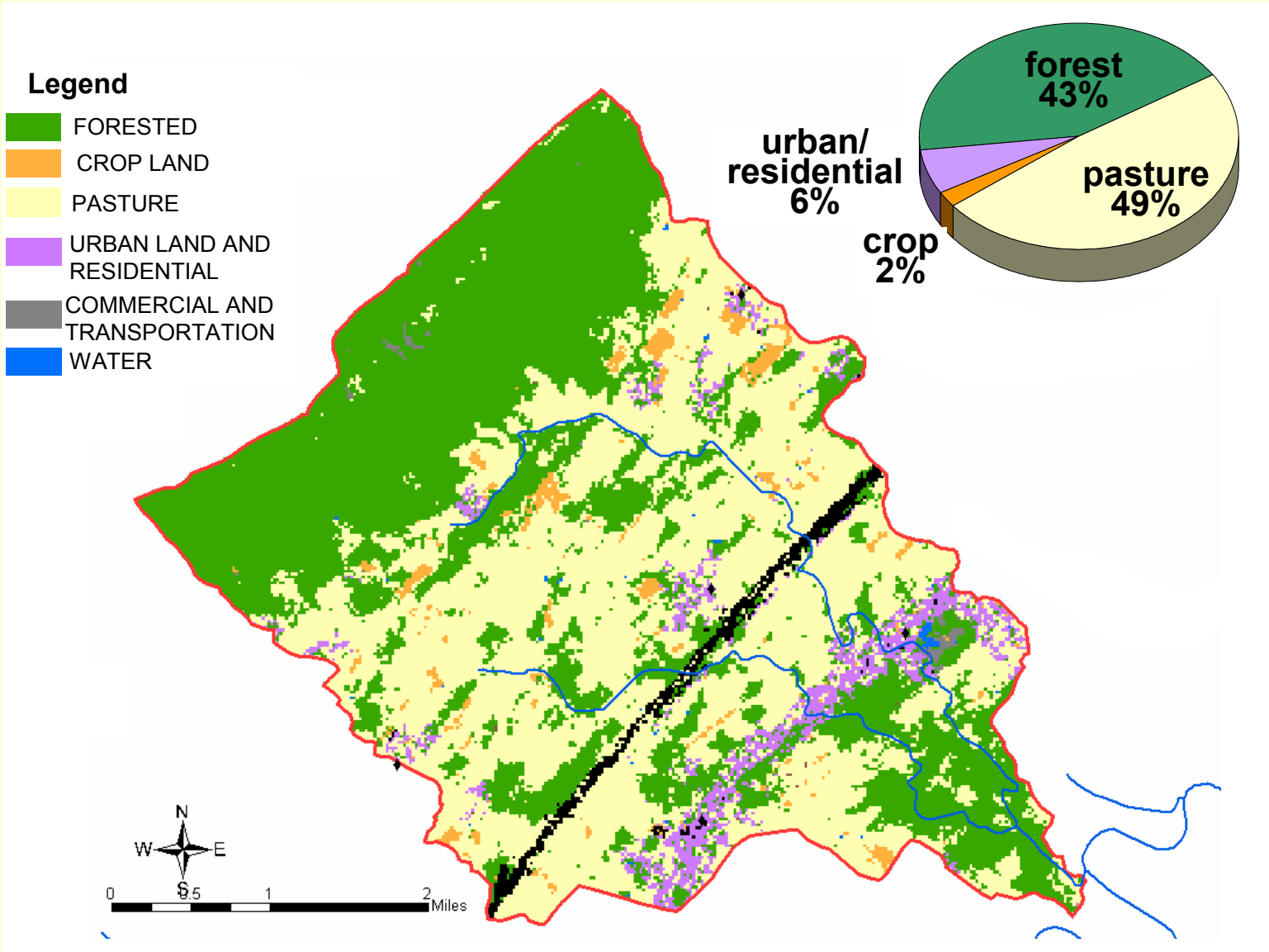
TMDL Study Overview

- Watershed location
- Benthic impairment
- Stressor analysis (What is the pollutant?)
- Identify and quantify pollutant sources
- Reference Watershed Approach
- Benthic TMDLs based on Sediment
- Allocation Scenarios

Watershed Location



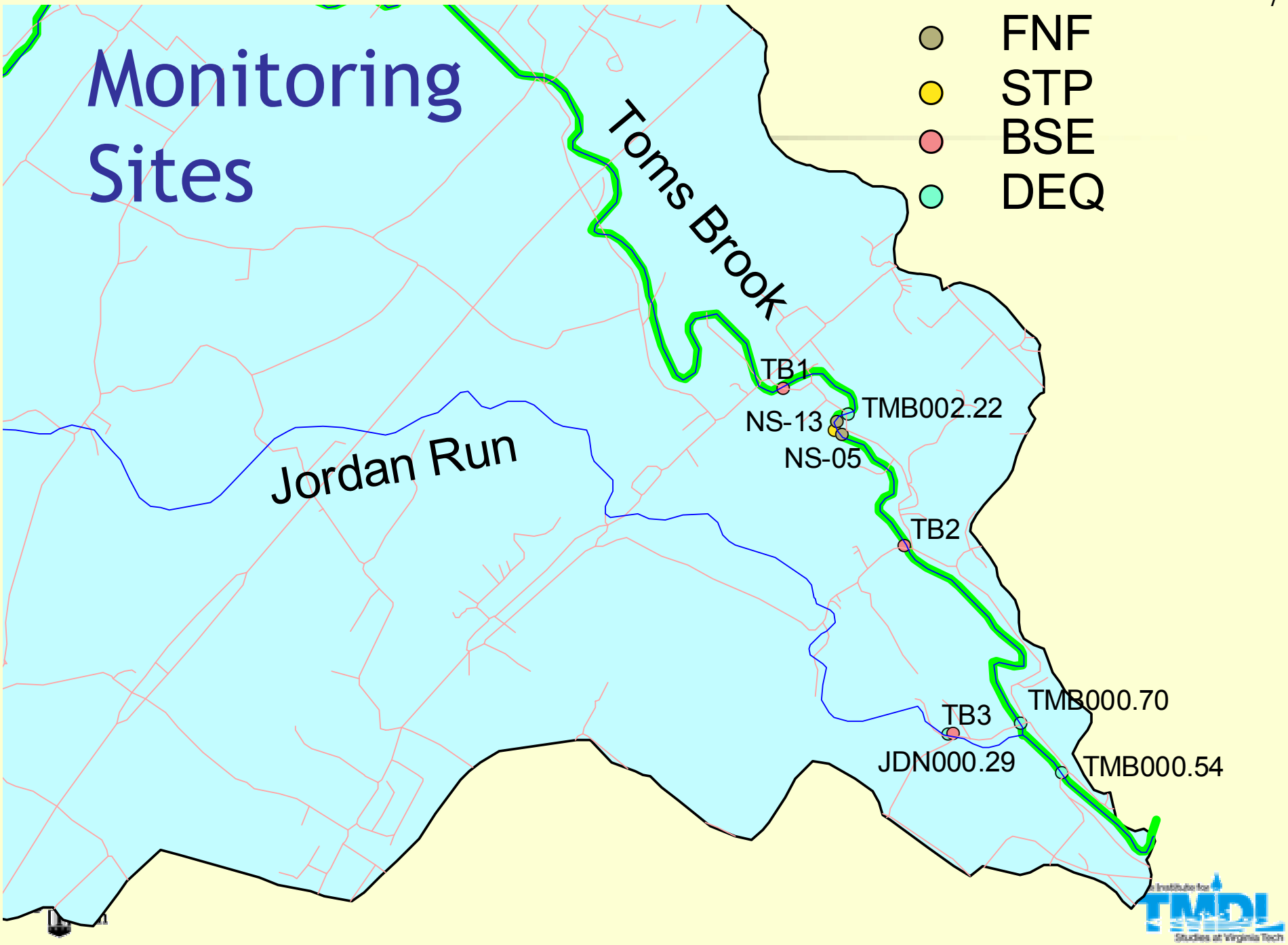
Major Land Uses
Toms Brook Watershed



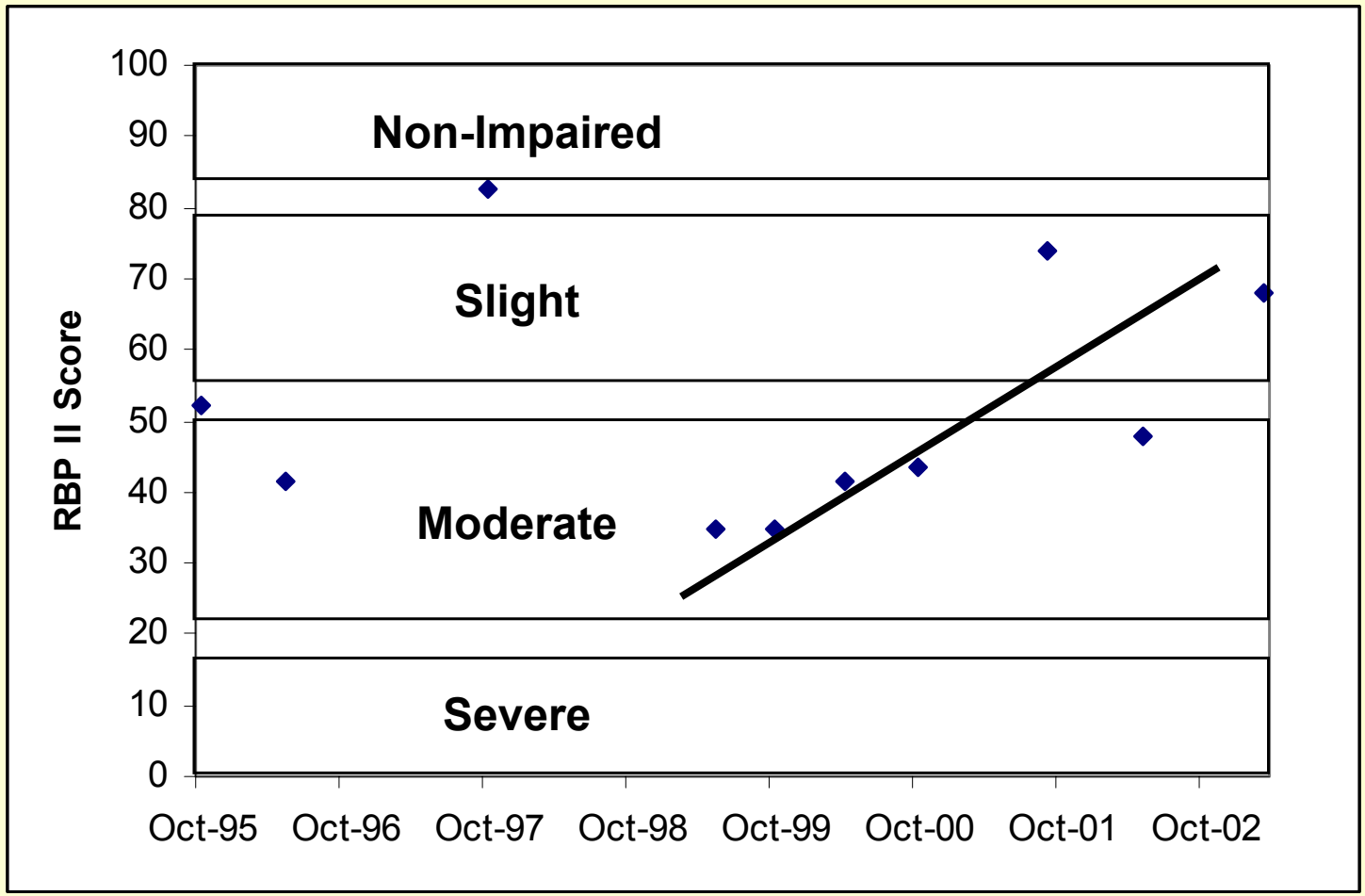
Impairment

Toms Brook has a **benthic** impairment.

This means that the stream does not meet state standards for biological health.


Monitoring Sites
FNF
STP
BSE
DEQ
Toms Brook
Jordan Run
TB1
TMB002.22
NS-13
NS-05
TB2
TB3
TMB000.70
JDN000.29
TMB000.54

Toms Brook RBP II Ratings



TMDL Listing if 2 or more ratings of "Moderate" or 1 rating of "Severe" during Assessment Period

Benthic Stressor Analysis Procedure

- Identify potential stressors
- Collect and analyze available data for each potential stressor
- Select the most probable stressor(s)
- Develop the TMDL for the selected stressor(s)

Stressors Considered

- Sediment
- Organic Matter
- pH
- Toxics
- Nutrients
- Temperature

Possible Stressors

- Sediment
- Organic Matter
- pH
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- Nutrients
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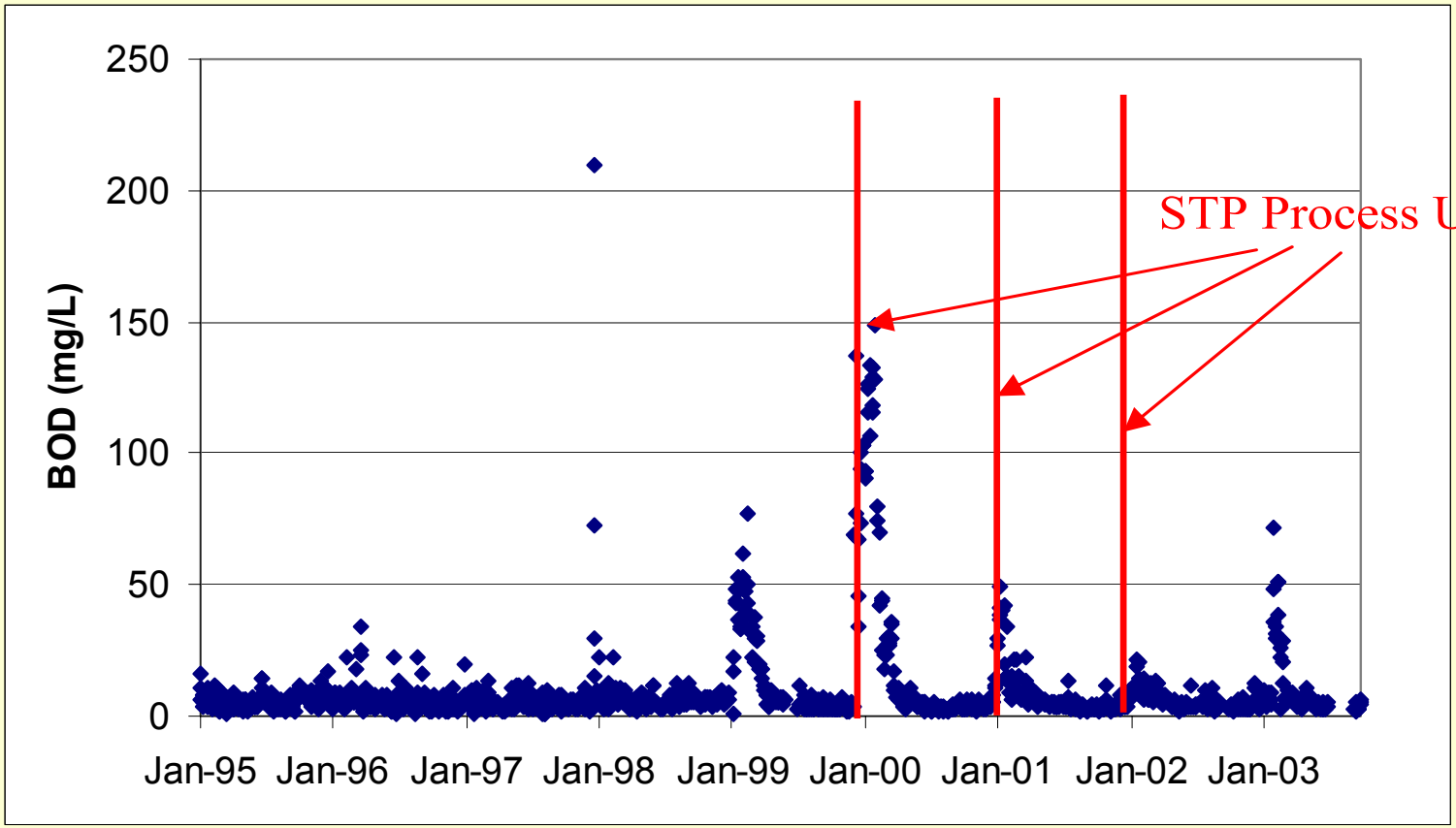
Possible Stressors

- Sediment
- Organic Matter
- 
- Toxics
- Nutrients
- Temperature 

Potential Point Source Problems

- Toms Brook-Mauertown STP

Toms Brook-Mauertown STP Process Upsets



Possible Causes of STP Upsets

- Inadequate capacity - overloading
- Toxic loadings
- Operational problems

Results of STP Investigation

- Upsets appear to be the result of infrequent shock loadings from the Bowman Apple Products Co.
- Toxicity? 3 negative tests since August
- DEQ and STP working to improve operator training
- No STP upset so far this winter!
- STP in compliance with operating permit.

Sediment as a Stressor

- Moderate to low embeddedness scores
- Recent precipitous drop in %Haptobenthos scores
- Larger TSS concentrations during storm runoff indicated by a few storm samples
- Preliminary modeling showed sediment loads higher than several potential reference watersheds

PRO

- Recent dominant species – Elmidae and Psephenidae – not tolerant of high sediment concentrations
- Overall habitat scores show consistent increasing trend
- Ambient TSS concentrations at or below MDL of 3 mg/L

CON

Toxics as a Stressor

- 2 metals exceeded consensus-based PECs in 1992, but not in 1996
- Shredder populations at 0 or low levels

PRO

- STP-reported process upsets and high ammonia concentrations in Dec-Jan 1999-2001, possibly others in previous years

- No DEQ-reported chronic or acute ammonia violations

CON

- No consistent pattern between STP process upsets and expected decreases in RBP II scores for samples taken in the following spring

Organics as a Stressor

- High BOD loads accompanying STP process upsets
- Dominance by *Chironomidae* and *Hydropsychidae* in 3 samples (1996-1999) and by *Asellidae* in 2002, that indicate an altered benthic community
- Moderate MFBI metric scores

PRO

- DEQ-reported BOD concentrations at or below MDL of 2 mg/L
- Ambient DO all above minimum WQS of 5 mg/L
- Dilution of STP effluent in Toms Brook by minimum factor of 20 in 2003
- STP-reported effluent DO all above WQS

CON

Nutrients as a Stressor

- Dominance of *Hydropsychidae* and *Chironimidae*
- Moderate MFBI scores
- Average nutrient concentrations sufficient for eutrophic growth

PRO

- Only 1 monitored exceedence of TP "threatened" criteria

CON

- Generally good riparian canopy decreases eutrophication potential
- Diurnal DO tests in 2002 and 2003 showed no DO violations – indicating non-eutrophic conditions

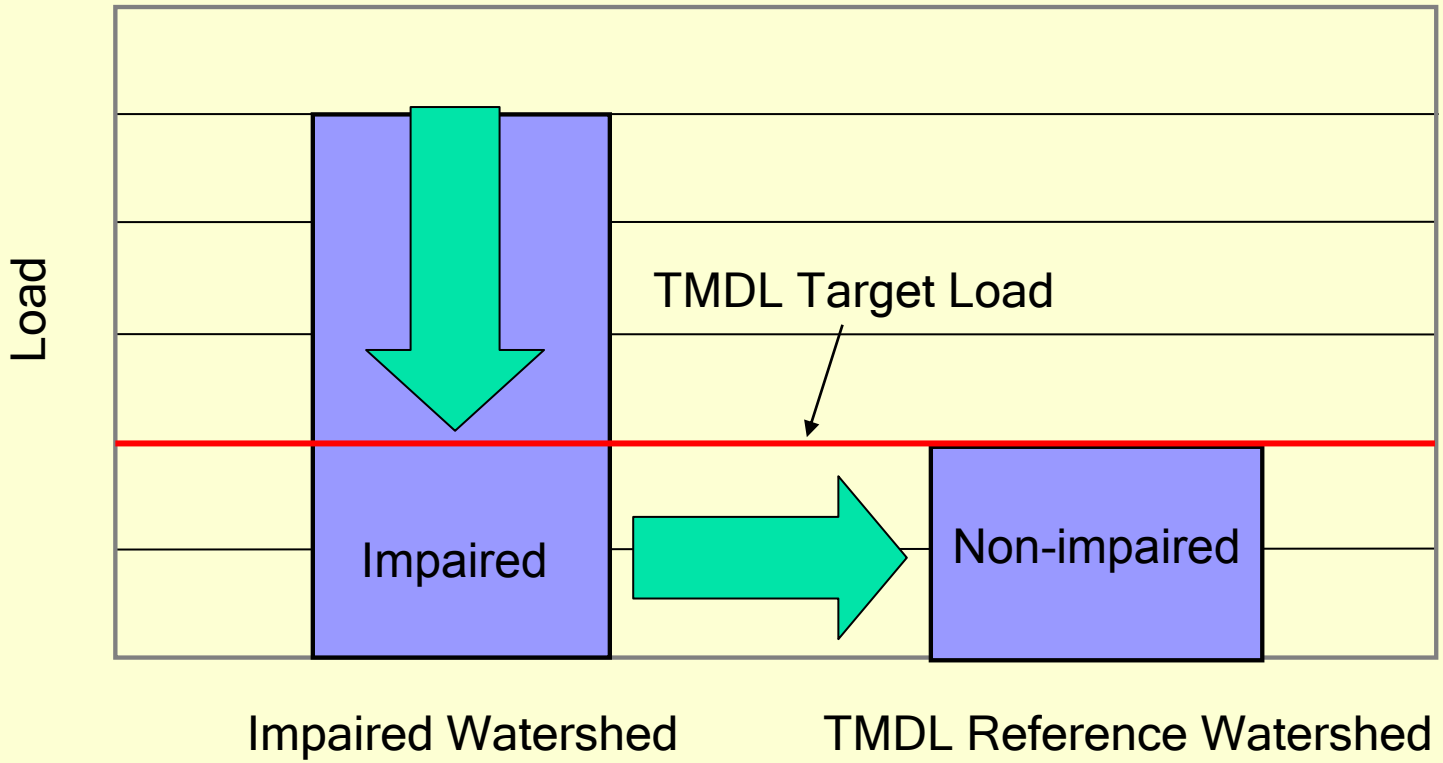
Sediment = Most Probable Stressor

- Impacts from three of the possible stressors – nutrients, organic matter, and sediment – are probably inter-related; toxics - historical.
- Best management practices employed to control sediment would also decrease nutrient and organics loadings.
- STP appears to have identified and controlled the source of the cold weather process upsets and associated loads of organics and ammonia.
- The ultimate criteria for judging the success of the TMDL will be the restoration of the benthic community itself – staged implementation.

Reference Watershed Approach

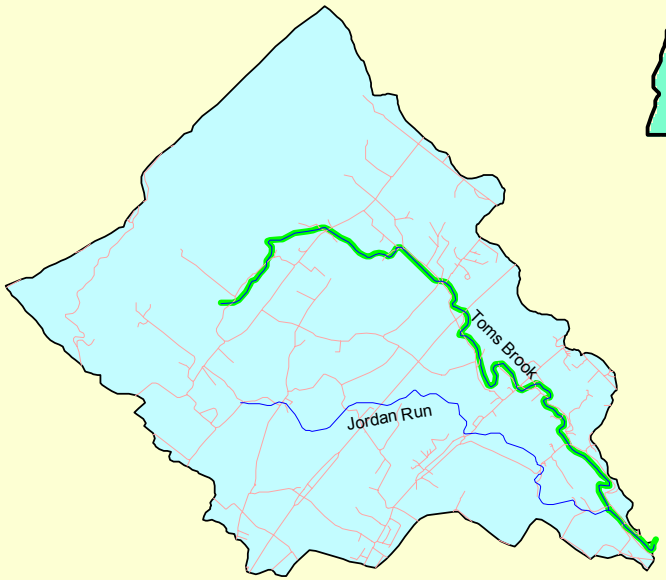
- Used in place of a numeric standard
- Uses a TMDL Reference Watershed
  - Has a healthy benthic community (non-impaired)
  - Similar characteristics to impaired watershed
- Defines the Target TMDL Sediment Load
  - TMDL Reference Watershed is area-adjusted to that of the impaired watershed
  - Existing conditions
  - Modeled load from TMDL Reference Watershed = TMDL Target Load

Example Benthic TMDL

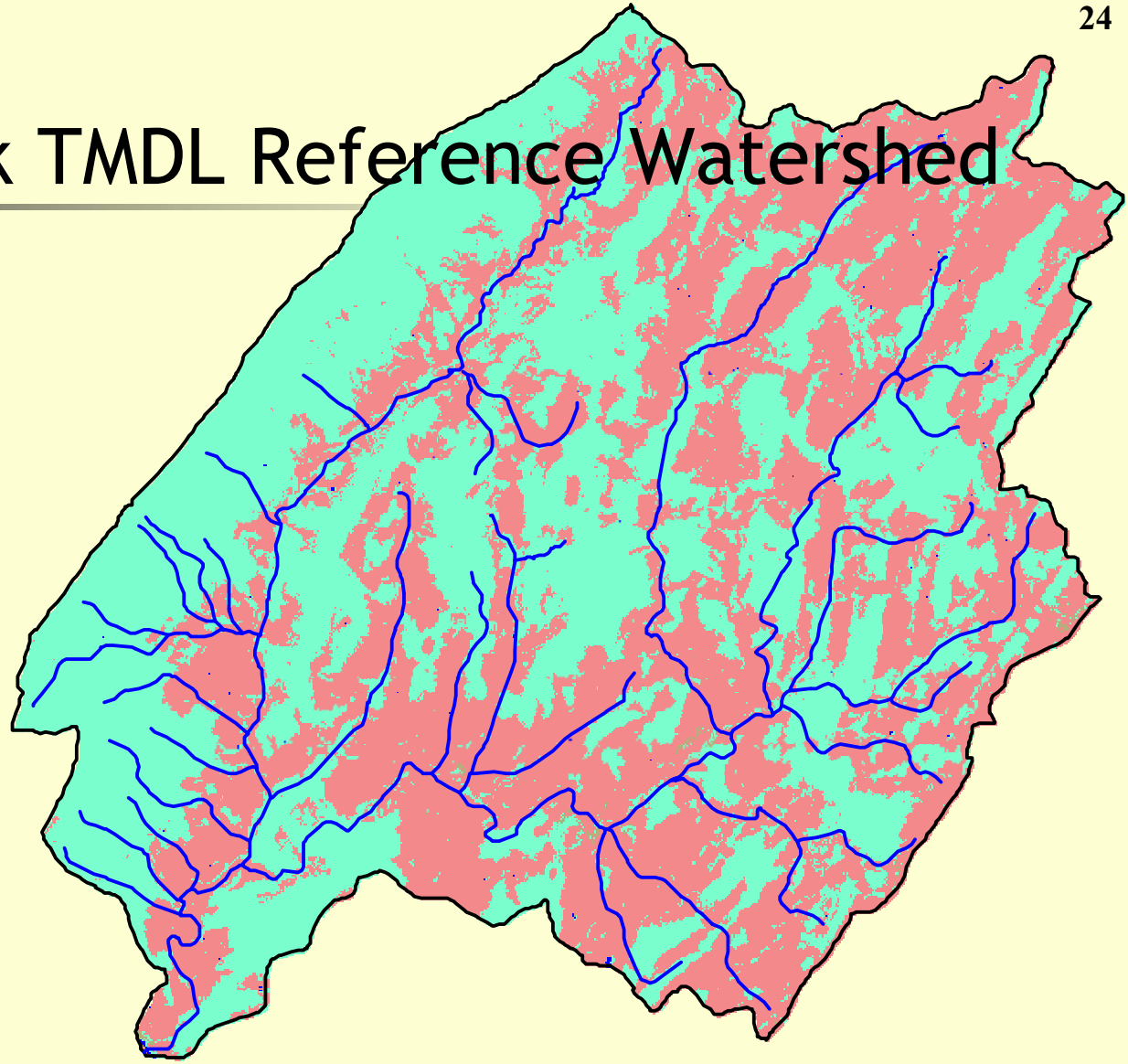


Reducing load in the impaired watershed to the target TMDL load is expected to restore the benthic community

Toms Brook TMDL Reference Watershed



Toms Brook

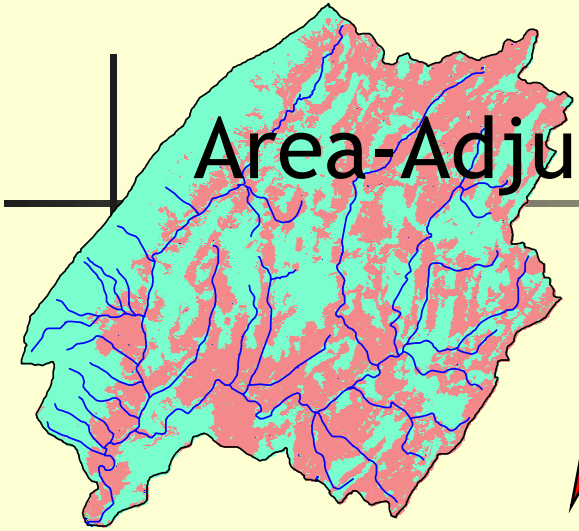


Hays Creek

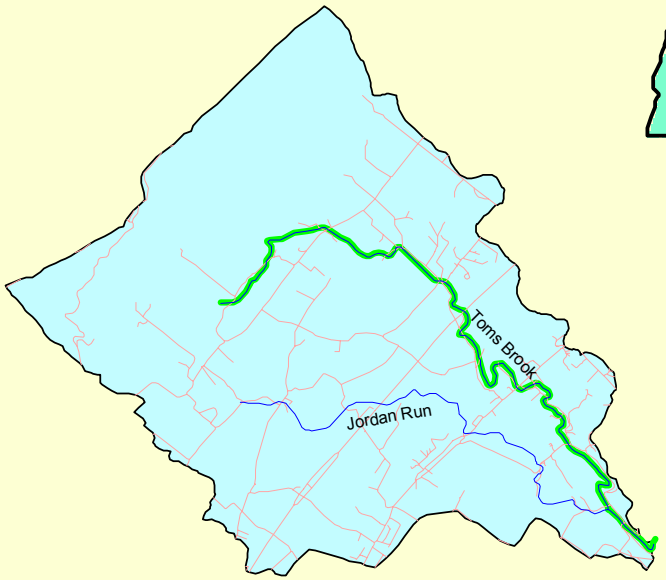
What is an Area Adjusted Watershed?

- Reduce/increase each source category (TMDL reference watershed)
- Proportional to the ratio of watershed areas
- Comparison of loads is then from equal areas

Area-Adjustment



4,252 ha



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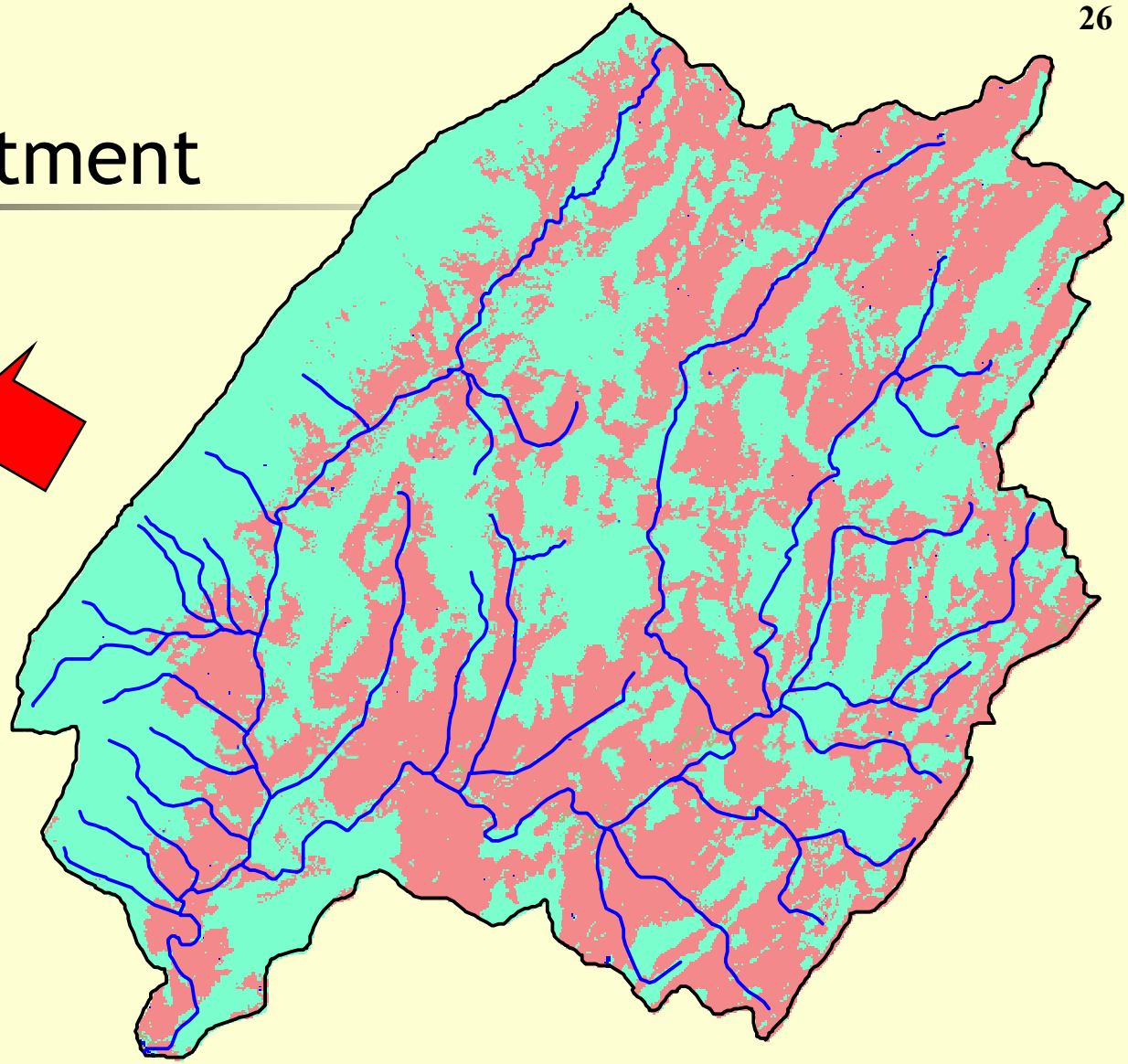
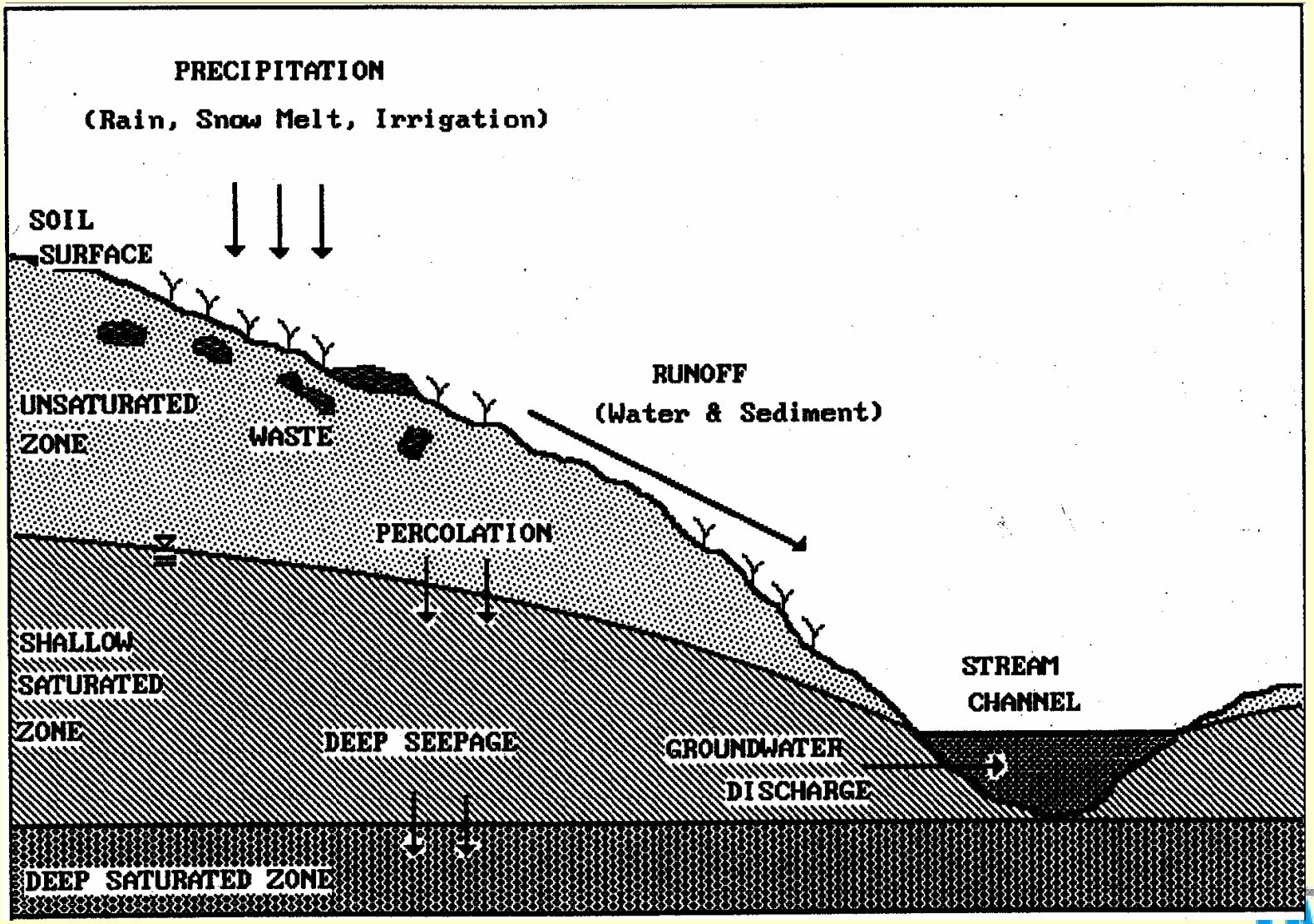


20,789 ha

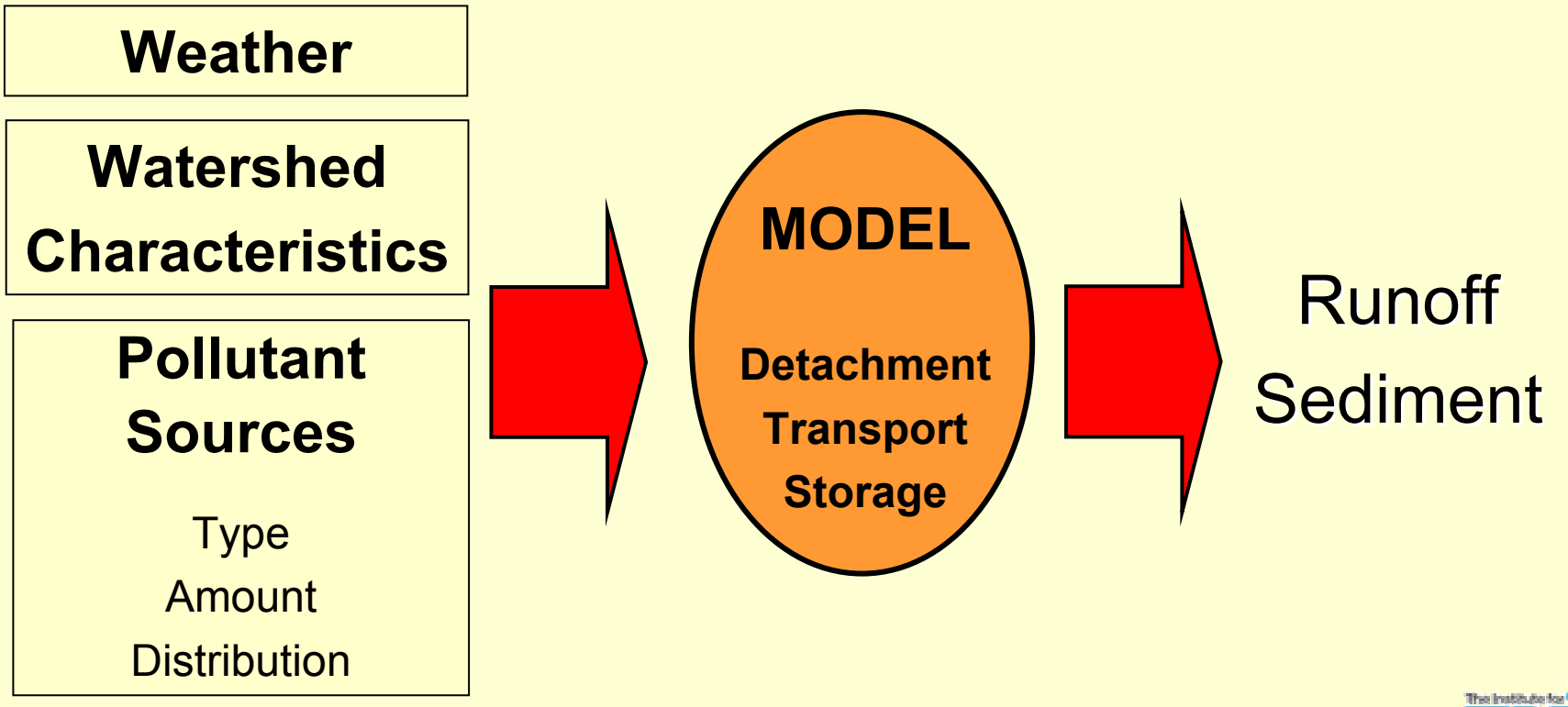
The GWLF Model

Generalized Watershed Loading Functions



The Modeling Process

- Define Inputs
- Model defines relationships
- Generate Outputs



Sediment Sources

- Impervious area wash-off
- Soil erosion
- Suspended solids from permitted sources
  - VPDES point sources
  - Municipal Separate Storm Sewer Systems (MS4)
- Channel erosion

Modeling Subwatersheds

Toms Brook Benthic TMDL

Existing Sediment Load – Toms Brook

Surface Runoff Sources	Toms Brook (t/yr)	Toms Brook (t/ha)	Area-adjusted Hays Creek (t/yr)	Area-adjusted Hays Creek (t/ha)
High Till	1,974.2	32.7	325.1	26.4
Low Till	466.3	1.8	1,015.0	19.1
Pasture	2,007.8	0.2	3,325.1	0.3
Forest	316.9	0.0	196.9	0.0
Pervious Urban	35.4	2.0	0.9	0.3
Impervious Urban	40.8	3.4	1.0	0.4
Other Sources				
Channel Erosion	259.5		2.0	
Point Sources	2.4		0.0	
Watershed Totals	**5,103.4**		**4,866.0**	

Target Sediment TMDL Load =	**4,866.0**	**t/yr**
10% MOS =	486.6	t/yr
Load for Allocation =	**4,379.4**	**t/yr**

Target TMDL Sediment Load

- t = metric ton = 1.102 tons

Permitted Sediment Sources

PS Discharger	VPDES_ID	Permitted TSS Loads					
		Drainage Area (acres)	Modeled Runoff (cm/yr)	Permitted Average Load (kg/day)	Permitted daily flow (MGD)	Permitted Ave Conc (mg/L)	Permitted Annual Load (t/yr)
Toms Brook STP	VA0061549				0.189	30	7.834
Industrial Stormwater							
RediMix Concrete	VAG110076	0.43	36.38			60	0.038
SFH General Permits							
	VAG401100				0.001	30	0.041
	VAG401123				0.001	30	0.041
	VAG401469				0.001	30	0.041
	VAG401368				0.001	30	0.041
	VAG401355				0.001	30	0.041
	VAG401427				0.001	30	0.041
Watershed Total							**8.121**

Toms Brook TMDL Sediment Load

TMDL = WLA + LA + MOS

- TMDL = total allowable daily load
- WLA = waste load allocation (point sources)
- LA = load allocation (non-point sources)
- MOS = margin of safety (10% of TMDL)

TMDL (t/yr)	WLA (t/yr)	LA (t/yr)	MOS (t/yr)
4,866.0	8.1	4,371.3	486.6
	VA0061549 = 7.83 VAG110076 = 0.04 SFH General Permits = 0.25		

TMDL - MOS = Load for Allocation = 4,379.4 t/yr

Sediment Allocation Strategies

- 11 Land Uses aggregated to 3 Source categories:
  - Agriculture
  - Urban
  - Forestry
- In addition to Channel Erosion and Point Sources
- No reductions from permitted point sources

Sediment Allocation Strategies

Reduction Scenarios

1. Equal percentage reductions taken from all four categories
2. Equal percentage reductions from 3 major categories
3. Larger percentage reduction taken from the largest load category – Agriculture, less from forestry and channel erosion

Toms Brook TMDL Allocations

Source Category	Reference Hays Creek (t/yr)	Existing Toms Brook (t/yr)	Toms Brook TMDL Sediment Load Allocations					
			TMDL Alternative 1		TMDL Alternative 2		TMDL Alternative 3	
			(% reduction)	(t/yr)	(% reduction)	(t/yr)	(% reduction)	(t/yr)
Agriculture	4,665.2	4,448.4	**14.3%**	3,812.1	**14.5%**	3,802.4	**15.1%**	3,776.4
Urban	1.9	76.2	**14.3%**	65.3	0%	76.2	0%	76.2
Forestry	196.9	316.9	**14.3%**	271.6	**14.5%**	270.9	**10.0%**	285.2
Channel Erosion	2.0	259.5	**14.3%**	222.4	**14.5%**	221.8	**10.0%**	233.5
Point Sources	0.0	2.4	0%	8.1	0%	8.1	0%	8.1
Total	**4,866.0**	**5,103.4**		**4,379.4**		**4,379.4**		**4,379.4**

What's Next?

- Draft TMDL Report Website:
  www.deq.state.va.us/tmdl/drftmdls/tomsbrk.pdf

- 30 day public comment
- Make appropriate changes
- Submit report to EPA for approval
- Develop an implementation plan

Acknowledgements

- Toms Brook STP – Rodney McClain, William Johnson
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- Lord Fairfax SWCD
- DEQ-VRO – Bill van Wart, Larry Hough

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